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EXPERIMENT STATION RESEARCHES IN HUMAN NUTRITION, FOODS TEXTILES, AND HOME MANAGEMENT, 1946

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EXPERIMENT STATION RESEARCHES IN HUMAN NUTRITION, FOODS, TEXTILES, AND HOME MANAGEMENT, 1946

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INTRODUCTION

A survey of research progress, as outlined in published and unpublished reports of the year's work of the experiment stations, indicates that work on the nutritive values of foods has continued to offer a rich field for investigation. This is not surprising considering the great number of foods and their natural variations; the new foods that are introduced or are developed by breeding, the constant development of new processing procedures, the significant number of nutrients that are known to be important in human nutrition and the new ones that are being discovered, and the constant development and improvement in methodology which affords a new approach to food investigations. The influence of these various factors is evident in the scope of the work on nutrients in foods reported within the year. This information on food values along with that on food production and consumption can give an over-all picture of how well the nation is fed.

Basic to any estimate of food needs, however, is a knowledge of the human needs for specific nutrients, how they are utilized by the body, and how much of them is required. The need for this basic information toward revising present estimates of nutrient allowances has been appreciated by station research workers as indicated by the increased number of nutrition investigations reported in the past year.

Methods, problems, and new developments in the field of food preservation have received attention, with greatest emphasis on preservation by freezing, and a few studies have dealt with problems of food preparation.

Outside the field of foods and nutrition, other studies that have particular importance for the home and the homemaker have been conducted on textiles and on problems of home management. The few textile researches have dealt with questions of use, serviceability, and care. As evidenced by an increased number of reports over those recorded in the past 3 years, there has been increased interest in home problems concerned with the over-all phase of management, including family economics, home equipment, time expenditures in homemaking, and the very pertinent question of housing.

The researches of the past year have included independent investigations by individual stations and also many cooperative studies. The Southern Cooperative Group has continued its research program on variations in the composition and nutritive value of vegetables grown

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in the South, and at the same time has participated in the National Cooperative Project, Conservation of Nutritive Values of Foods. The latter project has continued to operate on the regional and the key-commodity bases as outlined in the 1943 report (pp. 73–75), and the Southern, Western, and North-Central groups have held regional meetings to report progress, discuss problems of sampling and methodology, reach agreement on the over-all plan of commodity reports, and plan for new work and future approach. As an outgrowth of the key-commodity plan, workers concerned with the nutritive value of meat held a separate commodity conference to consider their very difficult and peculiar problems of sampling and methodology and to formulate the scope and plan of work for the meat investigations.

The North-Central cooperative regional project on the nutritional status of college women, sponsored by certain home economics sections of the experiment stations of the North Central States, has continued active. The eleventh research conference of workers engaged in this project was held within the year to edit manuscript material available and to plan for the completion of small pieces of work needed to round out the material for the final cooperative bulletin on this project.

NUTRIENTS IN FOODS—SCOPE OF INVESTIGATIONS

A check list presented on page 120 reveals that within the year there have been reports from 35 stations covering more than 100 investigations on nutrients in foods and on factors affecting the nutrient content. In general, the studies concerned agricultural commodities of importance to the region and included vegetables, fruits, cereals, and animal products in either the fresh or the processed state. A few of the studies were of the survey type as, for example, the Wisconsin station survey of canned foods to determine their content of some of the newer B-complex factors, namely, pyridoxine, biotin, and folic acid. Some of the values obtained in this study may be subject to reinvestigation with further developments in analytical procedures, but with methods presently in use canned salmon, yellow corn, and tomatoes were found to be good sources of pyridoxine, canned salmon the highest in biotin content, and the canned green vegetables highest in folic acid. Another survey study, not noted in the check list, was that made by the Puerto Rico University station to determine the value as a source of riboflavin of 93 foods either produced or commonly consumed in Puerto Rico and the neighboring islands.

While some of the studies reported were of the survey type, most of them dealt with some particular phase of investigation such as the influence of varietal differences, environment, maturity, storage conditions, cooking, canning, freezing, dehydration, or other processes on the content of one or more nutrients. Of the latter, the vitamins received most attention—each food being studied primarily for those vitamins occurring therein in nutritionally significant amounts. In a few instances, mineral values, chiefly calcium and phosphorus, were determined, and a brief beginning was made toward evaluating the nutritional quality of food protein in terms of the content of essential amino acids. The one protein study of this type was concerned with mushrooms which on the basis of very early studies have been rated

as having negligible protein value. The Massachusetts station obtained data by microbiological assay methods on the amino acid content of mushrooms. These results on the amino acid make-up of the mushroom protein together with other analytical data showing the mushrooms to contain about 2.7 percent of protein suggested that fresh mushrooms, while not comparable to such foods as meat and fish, are comparable to many fresh vegetables as a source of protein.

Check list, with reference citations, of experiment station research on nutrients in foods and factors influencing the nutrient content

No.	Food	Nutrients											Factors										Reference	Station	No.
		Ascorbic acid	Thiamine	Riboflavin	Niacin	Pantothenic acid	Pyridoxine	Folic acid	Biotin	Carotene, vitamin A	Minerals	Protein, amino acids	Environment [1]	Variety	Maturity	Holding, storage	Cooking	Canning	Blanching	Freezing	Dehydration	Other	Milling			
	Vegetables:																								
	Asparagus:																								
1	Fresh	x														x								Ice and Refrig. 111 (1): 19–22. 1946	Ga	1
2	Canned						x	x	x															Jour. Nutr. 31 (3): 347–353. 1946	Wis	2
	Beans, snap:																								
3	Fresh	x								x			x	x										Amer. Soc. Hort. Sci. Proc. 45: 387–390. 1944	Fla	3
4		x																	x					Food Res. 10 (6): 518–524. 1945	Ill	4
5		x	x		x					x							x	x		x	x	(2)		Mo. Sta. Bul. 491: 5–9. 1945	Mo	5
6		x	x											x		x	x							N. C. P. Progress Notes 117, 118, 122. 1946 [3]	Minn	6
7		x														x								Ice and Refrig. 110 (1): 33–34. 1946	N. C	7
8		x									x								x		x			Food Res. 10 (4): 342–350. 1945	Va	8
9		x																x						Wyo. Sta. Project Rpt. (Unpublished)	Wyo	9
10	Canned						x	x	x															Jour. Nutr. 31 (3): 347–353. 1946	Wis	10
11	Frozen	x	x	x													x							Amer. Dietet. Assoc. Jour. 22 (7): 605–610. 1946.	N. Y. (Cornell)	11
12	Dehydrated	x									x					x	x							Food Res. 10 (4): 342–350. 1945	Va	12
13	Dry seed		x	x	x									x										Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	13
	Beans, lima:																								
14	Fresh	x														x								Ice and Refrig. 110 (1): 33–34. 1946	N. C	14
15		x	x	x									x	x	x	x	x							South. Coop. Ser. Bul. 5. 1946	South Coop. [4]	15
16		x																	x					Amer. Dietet. Assoc. Jour. 21 (5): 289–290. 1945.	Utah	16
17	Canned	x	x	x		x				x						x								Indus. and Elgin Chem., Indus. Ed. 37 (12): 1240–1243. 1945.	Pa	17
18		x															x							Amer. Dietet. Assoc. Jour. 21 (5): 289–290. 1945.	Utah	18
19	Frozen	x	x	x													x							Amer. Dietet. Assoc. Jour. 22 (7): 605–610. 1946.	N. Y. (Cornell)	19
20		x															x							Amer. Dietet. Assoc. Jour. 21 (5): 289–290. 1945.	Utah	20
21	Dry seed		x	x	x																			Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	21

	Cabbage:																											
22	Fresh	x								x			x	x												Amer. Soc. Hort. Sci. Proc. 45: 387–390. 1944	Fla	22
23		x															x									N. C. P. Progress Note 116. 1946 [3]	Minn	23
24		x														x										Ice and Refrig. 110 (1): 33–34. 1946	N. C	24
25		x															x									N. C. P. Progress Notes 124, 125. 1946 [3]	Tenn	25
26		x															x									Farm and Home Sci. [Utah Sta.] 7 (1): 5, 11. 1946.	Utah	26
	Carrots:																											
27	Fresh									x	x					x						x				Inst. Food Technol. Proc., 1945: 29–34	Ind	27
28										x					x	x										Mass. Sta. Bul. 428: 51. 1945	Mass	28
29		x								x			x		x											N. Mex. Sta. Rpt., 1945: 48–49	N. Mex	29
30										x												x				Food Res. 10 (6): 457–460. 1945	Texas	30
31	Canned						x	x	x																	Jour. Nutr. 31 (3): 347–353. 1946	Wis	31
32	Dehydrated		x	x	x					x							x									Food Res. 11 (1): 61–68. 1946	N. Y. (Cornell)	32
	Cauliflower:																											
33	Fresh	x																		x						Food Res. 10 (6): 518–524. 1945	Ill	33
	Collards:																											
34	Fresh	x		x						x			x	x		x										Res. and Farming [N. C. Sta. Rpt., 1944] 3 (4): 85. [1945.]	N. C	34
	Corn:																											
35	Canned	x	x	x		x				x						x										Indus. and Engin. Chem., Indus. Ed. 37 (12): 1240–1243. 1945.	Pa	35
36							x	x	x																	Jour. Nutr. 31 (3): 347–353. 1946	Wis	36
	Cowpeas:																											
37	Dry seed		x	x	x																					Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	37
	Kale:																											
38	Fresh	x														x										Del. Sta. Pam. 23. 1946	Del	38
39		x			x	x				x			x		x											Amer. Jour. Diseases Children 70 (5): 298–300. 1945.	Mass	39
40										x	x		x													Food Res. 10 (5): 401–407. 1945	Mass	40
41		x														x										Ice and Refrig. 110 (1): 33–34. 1946	N. C	41
	Lentils:																											
42	Dry seed		x	x	x																					Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	42
	Mushrooms:																											
43	Fresh			x	x	x			x			x				x	x	x	x							Mass. Sta. Bul. 428: 44. 1945	Mass	43
44	Canned			x	x	x			x																	Ibid	Mass	44
	Mustard greens:																											
45	Fresh	x														x										Ice and Refrig. 110 (1): 33–34. 1946	N. C	45
	Onions:																											
46	Fresh	x															x									N. C. P. Progress Note 114. 1946 [3]	Minn	46
	Peanuts:																											
47	Dry seed		x	x	x																					Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	74
	Peas:																											
48	Fresh	x														x	x	x		x	x					Indus. and Engin. Chem., Indus. Ed. 38 (6): 654–657. 1946.	Md	48
49		x															x									N. C. P. Progress Note 115. 1946 [3]	Minn	49
50		x	x	x						x				x	x											Inst. Food Technol. Proc., 1945: 158–159	N. Y. State	50
51		x	x	x											x			x		x						Utah Sta. Project Rpt. (Unpublished)	Utah	51
52	Canned						x	x	x																	Jour. Nutr. 31 (3): 347–353. 1946	Wis	52
53	Frozen	x	x	x													x									Amer. Dietet. Assoc. Jour. 22 (7): 605–610. 1946.	N. Y. (Cornell)	53
54	Dry, split		x	x	x																					Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	54

See footnotes at end of table.

Check list, with reference citations, of experiment station research on nutrients in foods and factors influencing the nutrient content—Continued

No.	Food	Nutrients											Factors										Reference	Station	No.
		Ascorbic acid	Thiamine	Riboflavin	Niacin	Pantothenic acid	Pyridoxine	Folic acid	Biotin	Carotene, vitamin A	Minerals	Protein, amino acids	Environment [1]	Variety	Maturity	Holding, storage	Cooking	Canning	Blanching	Freezing	Dehydration	Other	Milling			
	Vegetables—Con.																								
	Peppers:																								
55	Fresh	x								x					x	x		x						Ga. Sta., 1945: 73	Ga	55
56		x								x								x			x			N. Mex. Sta. Bul. 327. 1946	N. Mex	56
	Potatoes:																								
57	Fresh	x														x								Amer. Potato Jour. 23 (6): 197–218. 1946	Me	57
58	Dehydrated	x	x	x	x												x							Amer. Dietet. Assoc. Jour. 21 (8): 518–521. 1945.	N. Y. (Cornell)	58
	Soybeans:																								
59	Canned		x							x	x	x		x	x	x								Md. Sta. Bul. A39: 67–86. 1945	Md.	59
60	Dry seed		x	x	x																			Jour. Nutr. 30 (1): 31–36. 1945	N. Y. (Cornell)	60
	Spinach:																								
61	Fresh	x															x							N. C. P. Progress Notes 124, 125. 1946 [3]	Tenn	61
62	Canned						x	x	x															Jour. Nutr. 31 (3): 347–353. 1946	Wis	62
	Squash, summer:																								
63	Fresh	x		x						x				x										Food Res. 10 (6): 489–496. 1945	Mass	63
	Sweetpotatoes:																								
64	Fresh	x								x				x		x								La. Sta. Rpt., 1945: 7	La	64
65		x	x	x													x							Amer. Dietet. Assoc. Jour. 22 (7): 605–610. 1946.	N. Y. (Cornell)	65
66		x								x						x								S. C. Sta. Rpt., 1945: 70	S. C	66
67		x								x			x			x	x							South. Coop. Ser. Bul. 3. 1945	South. Coop. [5]	67
68			x	x	x									x			x					(6)		Food Res. 10 (4): 325–329. 1945	Texas	68
69	Dehydrated	x								x	x					x	x		x					Inst. Food Technol. Proc., 1945: 3–12	Va	69
	Tomatoes:																								
70	Fresh	x																x						La. Sta. Rpt., 1945: 5–6	La	70
71		x																x						Nebr. Sta. Rpt., 1945: 42	Nebr	71
72		x														x								Ice and Refrig. 110 (1): 33–34. 1946	N. C	72
73		x														x		x						Ohio Sta. Bimo. Bul. 239: 44–46. 1946	Ohio	73
74	Canned	x			x					x							x							Amer. Dietet. Assoc. Jour. 22 (1): 29–31. 1946.	N. Y. (Cornell)	74
75							x	x	x															Jour. Nutr. 31 (3): 347–353. 1946	Wis	75

	Tomato Juice:																										
76	Fresh	x																x						Jour. Nutr. 30 (6): 435–442. 1945	N. Y. State	76
77	Canned	x	x	x		x				x						x								Indus. and Engin. Chem., Indus. Ed. 37 (12): 1240–1243. 1945.	Pa	77
	Turnip Greens:																										
78	Fresh	x								x							x							Ga. Sta. Rpt., 1945: 73	Ga	78
	Fruits:																										
	Apples:																										
79	Fresh	x											x											Iowa Sta. Rpt., 1945, pt. 1: 263–264	Iowa	79
80		x											x											N. Y. State Sta. Rpt., 1945: 25	N. Y. State	80
	Blueberries:																										
81	Fresh	x														x								Ice and Refrig. 110 (1): 33–34. 1946	N. C	81
	Cantaloups:																										
82	Fresh	x														x								Del. Sta. Pam. 23. 1946	Del	82
	Grape Juice:																										
83	Fresh		x	x		x	x															(7)		Food Res. 10 (4): 334–341. 1945	Calif	83
	Peaches:																										
84	Fresh	x								x								x		x		(8)		S. C. Sta. Rpt., 1945: 70–72	S. C	84
85	Canned						x	x	x															Jour. Nutr. 31 (3): 347–353. 1946	Wis	85
86	Frozen	x														x								Friut Prod. Jour. & Amer. Food Mfr. 25 (4): 101–103. 1945.	La	86
	Rose hips:																										
87	Fresh	x																x		x	x			Food Res. 10 (5): 392–396. 1945	Idaho	87
	Strawberries:																										
88	Fresh	x											x											La. Sta. Rpt., 1945: 6–7	La	88
89		x										x	x							x				N. Y. State Sta. Prog. Rpt. No. 6511. (Processed.)	N. Y. State	89
90		x														x								Ice and Refrig. 110 (1): 33–34. 1946	N. C	90
	Cereals:																										
91	Rice		x	x	x											x	x					(9)	x	Ark. Sta. Bul. 458. 1945	Ark	91
92			x													x								Amer. Dietet. Assoc. Jour. 21 (6): 345–347. 1945.	Hawaii	92
93	Wheat		x													x								Food Res. 10 (6): 485–488. 1945	Kans	93
	Animal products:																										
	Eggs:																										
94	Fresh		x	x													x							Amer. Dietet. Assoc. Jour. 22 (4): 315–317. 1946.	Idaho	94
95	Dehydrated									x						x								Food Res. 11 (1): 39–40. 1946	Ind	95
96			x							x						x								Mo. Sta. Bul. 491: 49. 1945	Mo	96
97	Ice cream	x		x						x														New England Jour. Med. 234 (2): 47–49. 1946.	Mass	97
98																x								Amer. Dietet. Assoc. Jour. 22 (8): 670–672. 1946.	Mass	98

See footnotes at end of table.

Check list, with reference citations, of experiment station research on nutrients in foods and factors influencing the nutrient content—Continued

No.	Food	Nutrients											Factors										Reference	Station	No.
		Ascorbic acid	Thiamine	Riboflavin	Niacin	Pantothenic acid	Pyridoxine	Folic acid	Biotin	Carotene, vitamin A	Minerals	Protein, amino acids	Environment [1]	Variety	Maturity	Holding, storage	Cooking	Canning	Blanching	Freezing	Dehydration	Other	Milling			
	Animal Products—Continued.																								
	Fish:																								
99	Fresh water	---	---	---	x	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Food Res. 11 (2): 179–186. 1946	Mich	99
100	Canned salmon	---	---	---	---	---	x	x	x	---	---	---	---	---	---	---	---	---	---	---	---	---	---	Jour. Nutr. 31 (3): 347–353. 1946	Wis	100
101	Turkey	---	x	---	---	---	---	---	---	---	---	---	---	---	---	---	x	---	---	---	---	---	---	Ky. Sta. Rpt., 1945: 11–12	Ky	101
102	Beef	---	---	---	---	---	---	x	---	---	---	---	---	---	---	---	x	---	---	---	---	---	---	Arch. Biochem. 10 (1): 107–111. 1946	Wis	102
103		---	x	x	---	---	---	---	---	---	---	---	---	---	---	---	x	x	---	---	---	(2)	---	N. C. P. Progress Notes 111, 127. 1945.[3]	Mont	103
104	Lamb	---	x	---	---	---	---	---	---	---	---	---	---	---	---	---	x	---	---	x	---	---	---	Utah Sta. Project Rpt. (Unpublished.)	Utah	104
105		---	---	---	---	---	---	x	---	---	---	---	---	---	---	---	x	---	---	---	---	---	---	Arh. Biochem. 10 (1): 107–111. 1946	Wis	105
106	Pork	---	---	x	---	---	---	---	---	---	---	---	---	---	---	---	x	x	---	---	---	---	---	Ky. Sta. Rpt., 1945: 9–11	Ky	106
107		---	---	---	---	---	---	x	---	---	---	---	---	---	---	---	x	---	---	---	---	---	---	Arch. Biochem. 10 (1): 107–111. 1946	Wis	107
108	Veal	---	---	---	---	---	---	x	---	---	---	---	---	---	---	---	x	---	---	---	---	---	---	Arch. Biochem. 10 (1): 107–111. 1946	Wis	108

[1] Including such factors as location, season, soil, and fertilization.
[2] Brining and pickling.
[3] National Cooperative Project, Conservation of Nutritive Value of Foods, Progress Notes. (Processed.)
[4] Virginia, Georgia, Mississippi, South Carolina, and Virginia Truck Stations, and U. S. D. A. Vegetable Breeding Laboratory.
[5] Georgia and North Carolina.
[6] Sprouting.
[7] Fermentation.
[8] Lye peeling.
[9] "Processing."

NUTRIENTS IN FOODS—RESEARCH METHOD OF INVESTIGATION

The research method utilized in these investigations on nutrients in foods is especially well illustrated by a number of particular studies.

Review of previous work to learn of positive and negative results obtained, of controversial and unsolved problems arising, and of methodology and techniques developed logically precedes any research undertaking in order to gain a picture of the new and unfinished work to be done and of the old work to be repeated for reevaluation by new and improved methodology. Pertinent bibliographies of such background material accompany most research reports but several annotated bibliographies prepared within the year by commodity chairmen in connection with the National Cooperative Project deserve particular mention because of their comprehensive nature and their classification and index features. These include a bibliography on spinach compiled at the Wyoming station with assistance of workers at the California, Colorado, Montana, Oregon, and Washington stations; one on the vitamin values for carrots compiled at the Colorado station; one on beef compiled at the Montana station with assistance from regional chairmen at the Texas and Indiana stations; and one on the influence of cooking processes on food nutrients prepared by workers at the North Carolina station with suggestions and aid from regional commodity chairmen at the New York (Cornell), Missouri, and Arizona stations.

Selection of a representative sample of the material or the population being studied is an essential step preceding actual analytical work to determine nutrient content. Because of the great variability of plant and animal material, the problem of adequate sampling often involves separate preliminary study. Such was the case at the Iowa station where it was found necessary to arrive at some decision as to what represented an adequate sample of apples for the estimation of mean ascorbic acid content. The great difference in the concentration of ascorbic acid of individual apples taken from the same tree, and the even greater differences in the ascorbic acid content of apples produced by different trees, showed the importance of using a large number of apples in a sample and of an equal distribution within the sample of apples derived from different trees. In addition, the apples from any one tree had to represent fruit picked from all sides of the tree because marked difference existed in the concentration of ascorbic acid in apples from the north and the south sides of a tree. It was found that the average concentrations of ascorbic acid in successive samples, each representing both the north half and the south half of each of 10 trees, were not statistically different from each other. A sample formulated on this basis, with the trees selected to represent the four quadrants of the orchard, provided a good base for evaluating the ascorbic acid value of apples from a given orchard.

In the sampling of tomatoes, as another example, the Nebraska station recognized the problem to be twofold: First, as to how many fruits should be analyzed, and second, whether the whole fruit needed to be analyzed or whether a fraction would suffice to give a reliable mean value. The latter point was important in relation to the saving of time and materials in the actual laboratory manipulations. As a result of a thorough study of sampling practices, it was determined that analysis of 20 tomatoes gave a mean ascorbic acid content which

was representative of the true mean of the lot and that analysis of either the whole fruit or a quarter cut as a radial sector or as a horizontal slice from the approximate center of the tomato resulted in a reliable mean value. This study emphasized further that individual tomatoes of the same sample differed so greatly in their ascorbic acid content that the range of values should also be reported along with the mean value and the standard deviation.

Analytical procedures for the determination of vitamins in foods have had to be developed along with researches to determine the nature and stability of the vitamins, how they are utilized by the animal, and whether they occur in the free or the bound form in plant and animal tissue. Actual use of the analytical methods in the hands of many workers and in application to many types of foodstuffs serves to test the general applicability of the procedures and leads to useful modifications and improvements, and even to the development of new methods. Such studies are at present a very essential part of the research on vitamins and amino acids in foods and many of the station researches, therefore, have been directed to problems of methodology.

A chemical method for the determination of vitamin A in whole dried eggs by use of chromatographic adsorption was developed by the Indiana station to take the place of previous chemical methods found unreliable and necessitating instead the use of the costly and tedious bioassay procedure. It is expected that the new method will be readily adaptable to the determination of vitamin A in other biological materials and will have wide application in the testing of food and feed products in both human and animal nutrition.

In a fluorophotometric assay of the riboflavin content of foods conducted earlier by the Massachusetts station, it was found that the recommended procedures were not entirely satisfactory with highly pigmented foods such as kale and baked beans. A comparison was therefore made of the biological, microbiological, and fluorophotometric procedures currently used in assays for the vitamin. The good agreement between certain modifications of these three methods, except in the case of the baked beans, indicated that one currently recommended step in the fluorophotometric procedure was responsible for marked error in the assay results. To eliminate the difficulty certain revision of the procedure was introduced; at the same time, it was found that both the fluorometric and the microbiological procedures could be simplified in certain respects.

Sample extraction and preparation procedures were devised or modified as a result of a number of investigations including that of the Wisconsin station on the preparation of samples for the microbiological assay of pantothenic acid; that of the Pennsylvania station on the use of 6 percent metaphosphoric acid as the medium of preference for stabilizing the ascorbic acid as extracted from peas in the Waring blendor; that of the New York State station on the indophenol-xylene extraction method for ascorbic acid and modifications for interfering substances; and that of the Wisconsin station on the liberation of compounds in the folic acid group. These are but some of the studies on methodology that have been necessary as part of the research on the nutrient content of foods.

The calculation of results of analytical determinations is often complicated by attendant changes in the sample in the course of analy-

sis or by other complicating factors not necessarily anticipated until after preliminary test runs have been completed. In such cases, further research is indicated to determine the proper basis for chemical calculations. The problem of calculating the amount of the carotene retained by carrots in the blanching step of various processing methods involved a special study by the New York State station to determine the best basis for expressing the calculated results. As a result of this technical study it was recommended that alcohol-insoluble solids, rather than total solids, be used as the basis for calculating vitamin values for carrots. Application of the method to other vegetables was also suggested.

Interfering factors in the calculation of retention of nutritive value of foods were investigated in a special study at the Tennessee station in connection with estimations of cooking losses in institutional cookery practice. The findings, primarily of interest to the technical worker, indicated that retentions on a dry basis cannot be measured by data taken at various steps in preparation unless the only change has been a moisture change, and that they cannot be measured on the wet basis unless there has been no change in dry weight. In order to calculate retention, data must include total weights of all component parts at each stage of sampling. Incidental to these results, was the finding that added fat cooked with leafy vegetables such as cabbage and spinach did not have any effect on the retention of the ascorbic acid in the greens.

Repetition of experiments with or without pertinent variation in procedure is the rule rather than the exception in studies of nutrients in foods because the variability from sample to sample, from place to place, from season to season, and from treatment to treatment suggests the advisibility of determining the range of variation and of basing any generalizations on more than a single test. The New Mexico station, for example, repeating the carotene and ascorbic acid determinations on carrots as obtained from successive spring and fall plantings over a 2-year period found that a gradual increase in carotene occurred during growth in all plantings, but that the very high values of the spring carrots were not reached by the slowly growing fall carrots.

In another series of experiments as carried out by the Minnesota station, different vegetables were found to respond differently to various methods of cooking insofar as ascorbic acid retention was concerned. The results collected so far indicate that general statements comparing the effects of methods of cooking upon the retention of ascorbic acid in vegetables are misleading, for the vegetable itself and the method of preparation for cooking influence the retentions. Thus, the present year's work shows that peas, boiling-onions, and cabbage retain a greater proportion of their original ascorbic acid when cooked in a tightly covered pan, pressure saucepan, or steamer, than when cooked in boiling water, while green beans broken into 1-inch lengths retain the same proportion of their original ascorbic acid regardless of the method of cooking. On the other hand, if the beans are prepared for cooking by cutting into narrow lengthwise strips, cooking in a tightly covered pan, pressure saucepan, or steamer again retains more ascorbic acid than cooking in boiling water.

Cooperative research as practiced in the closely integrated research program of the Southern Cooperative Group and in the coordinated program of the National Cooperative Project has offered an approach which has expedited the solution of problems. Illustrative of the Southern Cooperative Group work is the recently reported study on lima beans which was cooperatively planned and executed by the Virginia, Georgia, Mississippi, South Carolina, and Virginia Truck Experiment stations and the U. S. D. A. Regional Vegetable Breeding Laboratory. The experiment was planned to determine the effects on nutritive value of such factors as variety, location, bean maturity, plant maturity, storage, and cooking and was further designed to admit of statistical analysis of the data. Lima beans of two varieties were each grown at the several locations from a common seed source under similar conditions of cultivation, harvested at agreed-upon stages of maturity of beans and plants, and analyzed by the same chemical procedures. Storage and cooking tests at the several locations were carried out under similarly controlled conditions. These controlled repetitions of the experiment from place to place with an effort to reduce station to station differences to a minimum served as necessary replications in the hands of several investigators simultaneously rather than in the hands of one investigator over a period of years. This approach permitted extensive results to be obtained in a comparatively short time, with the additional advantage of gaining information on the effect of environmental influences.

The approach followed in the National Cooperative Project has been a closely coordinated one designed to obtain an over-all picture of factors affecting the nutritive value of foods. According to this plan, individual stations agree to investigate various phases of a study, keeping in mind the over-all objective, agree to follow similar chemical and sampling methodologies insofar as practicable, and to pool the results of their independent studies toward giving a composite picture of the influence of many factors on the various foods. From the check list (pages 120–124), which is based largely on studies conducted under the National Cooperative Project, it is apparent that within the year this coordinated group attack has contributed much information on the problem of conserving the nutritive values of foods.

NUTRITION INVESTIGATIONS

Dietary habits and nutritional status, when evaluated with respect to each other, afford an over-all appraisal of the benefits of applied nutrition teachings. The benefits of a school lunch program, for example, were observed in a South Carolina station study and again in a study by workers at the Florida station. In the former study, children in two rural elementary schools in the upper Piedmont of South Carolina were observed for about 1⅓ years during which time the children in one school received in the winter sessions a complete hot lunch, while children in the other school received only a partial lunch consisting of foods that could be served without cooking. These lunches were in addition to the home food supply. A higher proportion of the children in the complete lunch group than in the partial lunch group made unusually good gains in height, and by the end of the period had the outward physical signs of good nutrition as observed by an experienced pediatrician. A somewhat larger pro-

portion of the children receiving the complete lunch than of those having a partial lunch at school improved the trend of their physical growth and development, and a smaller proportion of them lost ground during the period of the study. The former group also maintained hemoglobin levels, whereas the latter group had hemoglobin values significantly lower at the close than at the beginning of the study. The investigators point out that the school lunch, while it alone cannot correct long-standing malnutrition, can play an important role in immediate improvement in the food intake of school children and in the nutrition education program which should have far-reaching and lasting effects.

The relation of diet of the Florida school children to tooth and bone structure was followed over the period 1941 to 1945 in children in certain schools. Roentgenological and dental examinations at the beginning of the study showed that about 70 percent of the children 6 to 10 years of age had some degree of retarded development of the wrist bones, about 80 to 85 percent of them had dental caries, and about 75 percent of them gingivitis. All the children showing severe caries and delayed development of the wrist bones were given special diet supplements. The continued yearly examinations showed that with improved diet there was progressive improvement of the wrist bones, and that by 1944 the dental caries and gingivitis had greatly decreased.

Adults also may benefit by improvement in dietary habits as observed in a study at the Iowa station of women in the fifth and sixth decades. Metabolism studies determined what the daily needs of these older women were for calcium, phosphorus, and nitrogen. A study of their customary self-chosen diets, containing only 1 cup of milk daily, showed that these diets did not adequately meet the individual body needs for the above elements. However, improvement of the diets merely with additional milk increased the intake and simultaneously the retention of these nutrients.

A dietary study by New York (Cornell) station workers of Cornell University women living under several different circumstances determined what their food intakes were over sample weekly periods. From this information on the foods eaten, the intake of specific nutrients—calories, protein, vitamins, minerals—was calculated and compared, not with the determined needs of the individuals, as was done in the Iowa study, but with the daily allowances recommended by the National Research Council. An examination of individual weekly averages showed that for all nutrients the intakes of all women were within the figures used for minimum requirements, which were taken as two-thirds of the National Research Council's recommendations. While all the diets met this test for minimum adequacy, certain groups, such as those in campus-controlled cottages where meals were served in a central dormitory, were better nourishment than others. Survey of individual food records for the intake of specific foods, such as milk, meat, eggs, vegetables, etc., indicated that many of the diets could have been improved by wiser selection of foods.

The availability of nutrients from foods was studied with human subjects to determine if these foods as actually utilized were the good sources of nutrients that their analyses indicated them to be.

The availability of ascorbic acid in cabbage, for example, was investigated at the Iowa station where six college women served as subjects. These women, it was found, utilized the ascorbic acid in the cabbage as well as they did an equivalent amount of the vitamin supplied in the form of pure crystalline ascorbic acid. Similarly, the ascorbic acid in papayas and guavas was as well utilized as the synthetic vitamin by the eight men and six women who served as subjects in experiments at the Hawaii station.

The availability of iron in Hawaii-grown vegetables was also determined by workers at the Hawaii station where rats were used as the test animals rather than human subjects. The trials confirmed the superior quality of the iron of legume seeds for hemoglobin regeneration in the rat, and showed further that taro corms and taro leaves, both important items in the diet of Polynesians, had a high percentage of available iron. From a technical standpoint, it was of significance to learn that the percentage of food iron, soluble in dilute acetic or in dilute sulfuric acid, bore no relationship to the availability as determined by bioassay. Experimental studies of iron availability are usually carried out on rats because of the difficulty of clinical investigations of this type. The advisability of repeating the work with other species was recognized by workers at the Wisconsin station who worked out a satisfactory technique for the use of the dog for studies of iron availability. In the course of this study, it was observed that the iron in bran was almost completely available, while that in spinach was only 20 to 40 percent available, as compared with the iron in ferric pyrophosphate.

The accessibility of vitamins in bakers' and "nutritional" yeasts was investigated at the Wisconsin station in tests on human subjects and also on rats which in these trials were found to respond similarly to the human subjects. It was shown that if the yeast cell was killed by boiling or by the process used in the commercial preparation of dried "nutritional" yeasts both the riboflavin and thiamine were released so that they could be utilized by the animal body. Live yeast as dried for bread making yielded a part of its riboflavin but practically no thiamine, while fresh compressed yeast ordinarily procurable withheld both its thiamine and its riboflavin from absorption in the human digestive tract and, further, took some thiamine from other digesting foods. These findings indicate that large sums of money have been spent by the American public on unavailable vitamins in compressed yeast.

The ability of the cow to transfer fluorine from forage, feeds, and drinking water to the milk becomes of importance in human nutrition because of the toxicity of fluorine in food supplies. The Arizona station was interested in this problem because many Arizona waters that cows might normally drink contain fluorine. In the experiments carried out, cows were given drinking waters containing from as little as 0.2 p. p. m. of fluorine to as much as 500 p. p. m. Analyses of the milk from these cows showed that there was a small but definite increase in the fluorine content, but that in no case, regardless of the fluorine content of the drinking water, did the fluorine content of the milk exceed 0.5 p. p. m. These results suggested that fluorine is not transmitted in toxic quantities to milk even when the lactating cows

are drinking water with a fluorine concentration far above that causing mottled enamel in children's teeth.

In continuance of this study of fluorine in foodstuffs, cereals, legumes, and vegetables were grown in soils artificially treated with fluorine compounds to concentrations of 500 to 3,200 p. p. m. of fluorine. While the fluorine concentration of the resulting plants was higher than that of plants in control plots receiving no fluorine, the amount deposited was not proportional to the amount in the soil. Since natural soils contain only traces of fluorine and since the excessively enriched soils produced relatively small increases in the plant fluorine content, it appears that plant foods grown on Arizona soils are not dangerously high in fluorine content. Vegetables cooked in water containing added fluorine were found to absorb some of the fluorine, suggesting, therefore, that it is not a wise policy to cook in flourine waters cereals, beans, and other dry foods that absorb large amounts of water during the cooking process.

The relative efficiency of proteins of different origin for meeting the needs of the animal body for growth, reproduction, and lactation is determined by feeding trials with experimental animals, usually rats, receiving the protein food in question as the sole source of protein in the diet. The use of this method at the Arkansas station in an investigation of the biological value of brewers' yeast and of cultured yeasts showed that certain strains of these yeasts in addition to furnishing an abundance of the vitamin B complex were excellent tissue builders when used as the only sources of protein in the diets of rats throughout three generations. Possibilities were visualized, therefore, of using yeast for food in world populations faced with shortage of protein foods. It was realized of course that yeast would never be used as a meat substitute, but as a dietary supplement to fortify grains, for example. The value of such supplementation was tested in experiments that showed that blends of yeast at the 1-, 3-, or 5-percent level with enriched white flour, corn meal, or polished rice increased the biological value of the protein of the mixture over that of cereal alone as judged by growth response of rats. Incidental to this study, it was observed that the proteins of polished rice were far superior to those in enriched white flour.

It is recognized that the nutritive value of a protein or mixture of proteins is dependent upon the amino acid make-up of the protein. Within very recent years developments in protein chemistry along with nutrition investigations have established the fact that there are certain "essential" amino acids, namely, those that cannot be synthesized by the animal at a sufficiently rapid rate from any substance in the diet. It appears further, therefore, that the biological value of a protein is limited by the relative proportions of essential amino acids contained in it. This suggests the desirability of analyzing foods for their content of essential amino acids, but such investigations have been handicapped by the lack of adequate analytical methods. Now that methods are available, although subject to further development and improvement, a limited beginning has been made in evaluating foods in terms of the amino acid make-up of their proteins. At this research stage, however, it is not so clear that the amino acid make-up of a protein is the only big factor limiting its utilization within the body.

Investigators at the Illinois station have, therefore, concerned themselves recently with a study of the relationship between the amino acid constitution of proteins and their value in animal growth by comparing the amino acid contents of certain food products as determined by modern methods, with the results of rat-feeding experiments designed to detect the amino acids limiting the protein value in the nutrition of growth. A method worked out for the computation of results involved estimating for each protein the percentage deviation of its contents of each essential amino acid (per 16 grams nitrogen) from the corresponding contents of a protein mixture, such as eggs, almost completely digested and well utilized by the rat. The amino acid limiting the value of a protein was thus revealed as the one whose percenage deficit from the standard protein (egg) was the greatest. In the 28 proteins and protein mixtures investigated the limiting amino acids thus indicated agreed with those determined in feeding experiments with only one or two exceptions. This method of evaluating protein quality gives promise, therefore, of usefulness to investigators who will continue the comparatively new approach to the work of determining the relative values of foods as sources of protein.

Information on the metabolism of nutrients, that is, on what proportions are excreted and retained in relation to the amounts absorbed from the digestive tract, is essential background information for determining the nutritional requirements of people of different sex, age, and activity. The dietary allowances recommended by the National Research Council as a working basis in planning diets and food supplies were formulated in considerable measure from available metabolism data. The allowances formulated in 1941 and subsequently revised are admittedly tentative for certain nutrients and subject to revision as increasing evidence becomes available. Data published within the year as the result of various metabolism studies at the stations will contribute measurably to this evidence.

Investigations by workers at the New York (Cornell) station on the calcium, phosphorus, and nitrogen metabolism of preschool children studied in successive periods over many weeks yielded data on the retentions of these elements, each as fed at several levels in the basic diets. These results were of value in assessing the young child's requirements for these nutrients. However, the variation in retention between children, and between different dietary periods for the same child suggested that factors other than diet alone regulated the retentions of these elements. Because of this child-to-child and period-to-period variation, Illinois station workers extended their studies of the calcium requirements of seven preschool boys over the very long period of 40 weeks, during which time calcium balances were determined at different levels of calcium intake. Values believed to be representative of the daily needs of each child were obtained. These values and further data on the rate at which each subject could utilize the calcium of milk gave figures for the food calcium requirements of each child; the values ranged from 35 to 57 milligrams per kilogram of body weight per day. These figures translated in terms of food indicated that with 300 milligrams of calcium per day from nonmilk foods, six of the children would have needed a milk supplement of 2 cups while one child would have needed 3 cups.

This variability in calcium metabolism and calcium requirements was also observed in adult subjects studied by another group of investigators at the Illinois station. On the basis of long-time metabolism studies of 19 men receiving a good diet, in which milk products or equally available calcium salts furnished 60 percent of the calcium intake, a value of 10 milligrams per kilogram of body weight per day was obtained as an average for the human adult calcium requirement. The investigators point out that such an average is of value in planning diets but that it is only of subsidiary value in forming decisions as to calcium undernutrition in a community. Because of the great adaptability of the human organism to wide ranges in calcium supply, individual or community intakes of calcium may fall markedly below the average requirement value and not indicate calcium undernutrition unless there is clinical or laboratory evidence of draining of minerals from the bony structure of soft tissues.

Studies of adult calcium metabolism by this latter group of Illinois workers, and likewise the several studies by the New York (Cornell) workers on calcium, phosphorus, and nitrogen metabolism of preschool children, brought out the fact that neither ascorbic acid, citric acid (or sodium or potassium citrates), nor the equivalent in orange juice fed as diet supplements, influenced the body's retention of calcium, phosphorus, or nitrogen. Experiments at the California station showed also that ascorbic acid had no influence on the beneficial course of iron therapy given to a group of children with low color index anemia accompanied by a borderline ascorbic acid status.

A comparison of thiamine synthesis and excretion in human subjects on synthetic and natural diets, led New York (Cornell) station workers to the conclusion that the recommended daily thiamine allowances for women might be lowered to 1.1 or 1.2 milligrams per day. This conclusion seemed logical considering the thiamine excretions of the women subjects, and their apparent well-being on intake of 0.84 to 1.00 milligrams of thiamine daily. A similar study on riboflavin gave less conclusive results than did the thiamine study, and suggested that excretion studies add information concerning riboflavin metabolism but do not give the answer to the question of riboflavin requirement.

Sweat, as an avenue of escape of nutrients absorbed through the intestinal tract, has not received very much attention. In connection with possible losses of nutrients through this avenue by men sweating at hard labor or in tropical climates, a series of experiments was carried out by Illinois station workers to determine the excretion of several vitamins in sweat and in urine by men subjected to comfortable, hot dry, and hot humid atmospheres. Studies on this problem reported within the year were concerned with the excretion of ascorbic acid and dehydroascorbic acid, inositol, para-aminobenzoic acid, pantothenic acid, and iodine. The data accumulated in these tests suggest that vitamin and iodine losses in sweat are small as compared to the daily excretion in the urine.

The basal metabolism of college women in several Midwestern States was investigated at the Kansas, Iowa, Minnesota, Ohio, and Oklahoma stations as part of the North-Central cooperative regional project relating to the nutritional status of college women. A previous study by workers on this project indicated significant differences

in the basal metabolic rates of college women in these States. In general, the basal rates were slightly lower in the warmest climates, yet the coldest weather did not always produce the highest rates. Because of this discrepancy, the study was extended to determine the effects on basal metabolism of season and associated factors. In this later study, 10 college women distributed in these 5 States deviating considerably in temperatures and other climatic conditions were studied over periods of 20 to 104 weeks for the different subjects. Individual tests ranging in number from 17 to 55 showed a good deal of variation for the same subject over the period of investigation. Although the response was not uniform, season was apparently a significant factor affecting the basal rate of 6 of the 10 subjects. Pulse, respiration, body temperature, outside temperature, humidity, and hours of sunshine were seemingly minor factors in the results obtained.

FOOD PRESERVATION—FREEZING

Varietal differences in fruits and vegetables were studied at the South Carolina station in relation to adaptability for freezing, and not all products were found suitable. The Louisiana station reported that, in general, vegetables which were commonly served raw as salads were unsuitable for freezing. Cantaloups, celery, cress, cucumbers, endive, lettuce, green onions, parsley, radishes, green peppers, tomatoes, and watermelons were so classified, and methods other than freezing were suggested for preserving artichokes, cabbage, herbs, onions, hot peppers, potatoes, and rutabagas.

The effects of preparation methods on frozen citrus hearts have been studied at the Florida station during the past year. The best samples obtained were prepared by precooling the fruit, peeling either mechanically or by hand, and subjecting to a slight vacuum which was broken with carbon dioxide gas before packaging. Studies made by the California station show that concentration of citrus juices may be accomplished by freezing to a slush then draining through a screen or cheesecloth. Concentrates made by this method gave the frozen product a fresher flavor than those made by the customary method of separation of ice and sirup by centrifuging. At the Tennessee station, fruit juice concentrates made of undiluted expressed juice containing 10 percent added sugar were stored for 1 year at 0° F. before examining, at which time they showed much of the flavor and aroma of freshly processed concentrate. Sweetened, frozen cubes made from the concentrates were of excellent quality. Investigations at the Texas station to study the effect of blanching Magnolia figs in steam at atmospheric pressure showed that peeling previous to blanching improved their appearance and flavor. The Georgia station has recommended two home and two commercial formulas for packing frozen Elberta peaches in which ascorbic acid as an antibrowning agent and citric acid as a stabilizer for the ascorbic acid are included.

Peas and snap beans blanched in hard water in preparation for freezing showed an increase in their calcium content according to work reported at the New York State station. Different types of blanching water were used in these experiments and other than this increase in calcium, no significant differences in the mineral or vitamin content were observed.

The Oregon station found that the defective flavors commonly observed in frozen corn-on-the-cob could be eliminated by drilling holes longitudinally through the cob to allow the blanching water or steam to enter the center of the ear and permit enzyme inactivation in at least 2 minutes' less time than was required for solid ears. The New York State station has recommended blanching periods for corn-on-the-cob according to the size of the ear. Factory and laboratory experiments conducted by workers from the California station show that water cooling and fluming of various fruits and vegetables was objectionable from the standpoint of of loss of nutrients and damage to flavor, while air cooling avoided these objections and appeared to be practicable commercially.

Methods of freezing range from very slow freezing, such as that accomplished by ordinary mechanical refrigeration or freezer locker, to very rapid freezing by immersion in a freezing liquid. The length of time required for foods to be frozen solid depends upon the size and type of container, the nature of the product being frozen, and the quantity placed in the freezer at one time. According to the Louisiana station, the main difference in foods frozen at different rates of speed is in the size of the ice crystals formed within the tissues of the foods. In general, slow freezing of foods induced the formation of large crystals, whose size increased up to as much as 500 or even 1,000 times that of the cells. Workers at this station found that the formation of large crystals resulted in crushing and rupturing of cells so that, upon thawing, the food became soft, lost juice, and created conditions for enzymes to act upon cell contents. With peas and snap beans, however, the New York State station found that the speed of freezing by the home processor had little effect on the vitamin content, flavor, or texture of the frozen product. To facilitate freezing, this station has recommended staggering the packages to be placed in the home freezer to provide air space between each package, and has suggested limiting additional frozen material to be added to the freezer to 20 one-pound packages.

Experimental studies were carried out on rates of freezing in farm- and domestic-type food storage cabinets and in commercial locker plants at the Pennsylvania station. Data were obtained on vegetables, meat, and poultry packaged under various conditions employing single-plate and air-blast methods of freezing. The freezing interval varied from 2 to 12 or more hours, depending on the size of the package and number of layers of wrapping material. The New Jersey station reported that all stages of freezing preservation require very low temperatures. For initial freezing, temperatures of 10 to 20 degrees below zero are advisable, and there is no danger of having them too low.

Preserving mediums, such as sirups, added to fruits before freezing checks the action of enzymes in the fruit during storage and protects fruit which may be exposed to the air. The Tennessee station found that a mixture of equal parts of 50 percent white corn sirup and 50 percent granulated sugar sirup was satisfactory for the freezing preservation of peaches, and that a small amount of pure sodium bisulfite (0.01 percent) added to the dry granulated sugar or sirup before packing was effective in preventing browning. The Massachusetts station treated McIntosh apple slices with 0.03 to 1.5 percent calcium chlo-

ride solution before processing, and has recommended this method for overcoming the mushy texture usually found when this variety of apples is canned or frozen.

Little or no sugar is required in the quick freezing of fruits since the sweetening may be added as the product is thawed out for serving, according to the New York State station. Strawberries and raspberries may be frozen without sugar with reasonably satisfactory results, while sweet and sour cherries are satisfactorily preserved with the use of 10 percent sugar sirup. This station also reports that rhubarb preserved by freezing without the addition of sugar is superior in flavor and color to that preserved by the old practice of sealing in water in fruit jars. The Iowa station has suggested cutting rhubarb into 1½-inch pieces and freezing the fresh raw product instead of scalding or precooking it.

Repacking frozen foods was found practicable at the Minnesota station when commercially frozen blueberries, sweet cherries, apricots, and peaches, packaged in 20- to 35-pound containers, were repacked into heavily waxed containers for home use. Repacking was started when the ice crystals between the fruit defrosted sufficiently for individual pieces to be separated from the original pack.

Frozen cooked foods have been investigated by a number of stations during the past year. The Georgia station reported that proper selection, preparation, packaging, cooking times and temperatures, and rapid cooling are the chief factors contributing to better quality in cooked frozen vegetables. They found that closed containers were best for cooking vegetables to be frozen because volatile flavors, partially water-soluble, were retained. Large cuts of meats, such as hams, shoulders, roasts, and turkeys were preserved in excellent condition when precooked by boiling, baking, or roasting. Frozen cooked vegetables and meat sauces showed indistinguishable characteristics from unfrozen sauces after heating and thawing. Breads of all kinds baked and kept for several months in storage were successful. However, workers at this station recognize major problems in the complexity of freezing these cooked products, examples being separation of fats in gravies, stews, and sauces; precipitation of certain proteins, as in egg whites; starch break-downs as in spaghetti and potatoes; and the loss of fresh flavors and aromas due to oxidation.

Staff members at the New York (Cornell) station have presented recipes for preparing frozen cooked foods. These include vegetable dishes, soups, meats, poultry, combination dishes, salads, sandwiches, hors d'ouevres, quick breads, yeast rolls, fruits, cakes, puddings, cookies, pies, and other desserts. Precooked vegetables when packed loose have been reported by the Washington station to be less desirable than those which have been heated just enough for proper blanching, covered with a cream sauce or meat broth, and then frozen.

FOOD PRESERVATION—CANNING

Canning studies made by the Massachusetts station show that this type of food preservation is cheaper than home freezing. Based on initial cost of $30.00 per cubic foot for freezer capacity and including depreciation, power, containers, and storage, the unit cost for preserving a pound of food by freezing is approximately 18½ cents as compared with 4 cents for canning.

Beef canning experiments conducted at the Georgia station show that aging at 36° to 38° F. for 8 days previous to cutting and processing improves the texture and flavor. Of 54 lots of steaks, roasts, and stew meat processed at 10 or 15 pounds pressure from 60 to 90 minutes, there were no losses by spoilage that could be traced to underprocessing. Processing at 10 pounds pressure developed the highest flavor and the best texture.

FOOD PRESERVATION—DEHYDRATION

Dehydration experiments with sweetpotatoes were continued this past year at the Tennessee station. The fresh sweetpotatoes were peeled, cut into slices and cubes, and then blanched in steam, and comparative tests of dehydration and freezing were made. Blanched sweetpotatoes held very well in frozen storage, while the unblanched frozen product lacked flavor and darkened somewhat. The blanched, partially dehydrated sweet potatoes retained good quality in storage at 0° F., and the completely dehydrated product retained quality after 6 months' storage at room temperature. Unblanched dehydrated sweetpotatoes were starchy and flavorless.

The Michigan station made a series of experimental studies on Montmorency cherries to determine the effect of enzyme inactivation prior to dehydration on the color retention and storage life of the dried product. They found that hot water blanches of 3 and 4 minutes' duration at 135° F. gave the most satisfactory product, but after 6 months' storage, even these cherries turned brown. Supplementary treatments were made, including the use of wetting agents, acids, salts, sugar, and liquid pectin. Workers at this station feel that further investigational work is necessary before dehydrated cherries will be able to compete economically with canned or frozen cherries in the pie trade.

Cooking and organoleptic tests on dehydrated products at the Iowa station indicated only fair preservation of flavor and quality in certain products as compared with the same products frozen. Apples, pears, corn, vegetable soybeans, and lima beans gave the most satisfactory dehydrated products on this comparative basis. Sulfite dips were investigated as a predehydration treatment for onions, carrots, and apples, and the products obtained were compared with those which had been subjected to scalding and fumes of burning sulfur. The sulfite dip gave better color retention and flavor, and apples and onions so treated remained a creamy white during storage and after cooking, while carrots retained more natural yellow color. Storage of these products at 20° to 24° F. or 50° to 60° resulted in a more desirable quality than higher ranges.

The same techniques as employed during the war for drying large amounts of penicillin and blood plasma by subjecting the materials in a frozen state to high vacuum were used by the New York State experiment station to "freeze-dry" fruits and vegetables. The frozen vegetables to be dehydrated were placed in a container where they were subjected to vacuum, and the moisture vapor given off by the material was drawn into a drum submerged in a mixture of dry ice and acetone which had a temperature of −100° F. The station scientists report that much study remains to be done to make the process practical as a method of food preservation, although results obtained thus far

demonstrated clearly the superiority of freeze-drying over the usual methods of dehydrating foods.

Studies with cold-mix dehydrated fruit spreads were continued at the Delaware station the past year. Gels of 45 percent soluble solids containing 50 milligrams of ascorbic acid per 42 grams finished gel were packed in sealed jelly glasses and stored for 19 days at temperatures varying from 25° to 50° C. Assays made at irregular intervals indicated appreciable loss of ascorbic acid; powders showed smaller losses than did the finished gels, suggesting that properly packaged gel powders may serve as carriers for vitamin C in the Army diet, providing proper storage temperatures are observed. Sucrose and dextrose were added separately or in various combinations with the other gel ingredients to give soluble solids above 45 percent in experiments to determine the means of dispersing high-methoxyl, intermediate-methoxyl, low-methoxyl pectins, as well as apple and citrus pectins. A total sugar content of 60 percent in the finished gel represented the highest limit of sugars, and on this basis, gel strength values were obtained showing that when sucrose was the only sweetening agent used a grainy texture developed. Gels were also made at this station by combining sweet-potato powder, dextrose, sucrose, commercial pectin, common salt, and spices. Other pectin studies have been reported by the Delaware station, including an experiment in which the extraction of certain fruit juices with the aid of polyphosphates improved the pectic quality of the juices in making jelly.

FOOD PREPARATION

Altitude cooking experiments, involving the use of tested recipes for cakes and corrections for their application in varying localities, were conducted at the Colorado station. Suggestions for measuring ingredients, equipment, and directions for general mixing and baking are presented in a bulletin published the past year by this station. The important features of altitude cookery, including the leavening correction, the sugar-water ratio as related to the type of shortening used, and baking temperatures are considered to be the important features of baking cakes and cookies when the problem of the structural strength of the egg and flour are involved.

The effect of different methods of combining the ingredients of a simple cake was investigated by the Kansas station. Batters with a wide range of consistency were obtained when the ingredients were mixed by the six methods used in the experiments, with each method tending to give a characteristic batter. Consistency and specific gravity were found closely related; cakes of low specific gravity yielded a tender, compressible product.

The tenderness of pastries made with different soya flours using a basic formula in three series of mixes containing various percentages of fat, were investigated at the Indiana station. The study furnishes evidence that the natural fat present in the flour is effective as a shortening agent in pastries made with soya flour.

Candies which were made with pectin, sugar, and either fruit puree or juice were prepared by the California station. The New York State station has studied the factors involved in the preparation of maple creams, a soft fondant made from pure maple sirup by boil-

ing rapidly until a temperature of 232° F. is reached, cooling rapidly to room temperature, and stirring until crystallization is complete.

Food substitute experiments were conducted at the New York (Cornell) station to determine the optimum extent to which cereals could be substituted for meat in ground meat loaves. In these tests, loaves made with soya grits as an extender scored slightly higher than those made with rolled oats or shredded wheat.

A formula was developed at the Missouri station for a loaf of yeast bread made of enriched flour, dried whole eggs, dried whole milk, fortified margarine, and yeast which would aim to furnish one-half of the daily nutritive requirements of a moderately active man.

TEXTILES

This year's report on textile research includes a study at the Ohio station on the selection of sewing thread. Different brands were observed to vary in price, balance of twist, seam strength, and color-fastness to laundering. Unmercerized cotton thread had the best balance of twist and caused least difficulty in hand sewing, while mercerized cotton and nylon threads were most poorly balanced and caused the greatest difficulty in hand sewing. Heavy duty cotton thread was outstanding in single strand strength, and it was the strongest when made up into seams, with nylon thread being next highest in seam strength. Research studies were also made at this station concerning the serviceability of 36 cotton and rayon glass curtain fabrics. Comparisons of the two types of fabrics showed that the cotton gave evidence of being more durable and serviceable than rayon fabrics of similar construction.

The physical properties of 13 blankets of varying fiber contents were determined in a study by the Kansas station. Blends of cotton and rayon, and of rayon, wool, and cotton, and an all-cotton blanket were found to be warmer than all wool ones, although in blankets of the same thickness, variations in protective value were small. It was also found that laundering and dry cleaning increased the protective value of wool blankets, but decreased that of the cotton ones.

The Montana station found that a nonsoap detergent used in either soft or hard water for washing 100-percent-wool blankets had better cleaning characteristics than soap. Part-wool blankets washed with soap in either soft, hard, or softened water were cleaner than those washed with the detergent. The nonsoap detergent used, sodium lauryl sulfate, was also applied in other washing tests, including infants' white woolen garments, linen napkins, cotton prints, and rayon wearing apparel. No significant differences were found in the effects of the soap and the nonsoap detergent on fabric strength and wearing quality, although soap had an appreciably greater cleansing value on cotton, linen, or mixed cotton and wool fabrics.

HOME MANAGEMENT

Time expenditure studies in homemaking activities at the Vermont station showed that the housewife spent an average of 64½ hours during 1 week on food preparation, housecleaning, dishwashing, and other activities. Persons other than the housewife gave an average of 17¾ hours to homemaking, with hired workers in 26 cases averaging 25½ hours for the week. In 9 percent of the homes, women and

girls of the family, other than the housewife, spent a total of 35 hours or more during the week on homemaking. Relationships between time expenditures and efficiency were found to be contributing factors to the allocation of time.

Eighty Negro and eighty white town families were interviewed by Mississippi station workers to ascertain the amount of time spent on homemaking activities. Analysis of the records showed that more time was spent by all groups in food preparation than in all other homemaking activities combined. Records kept by these 160 homemakers in the summer of 1943 revealed a total of 1,857 dishes prepared during the 1 week studied. Food preparation practices of each family rated according to the average number of good, poor, and fair practices per dish revealed that 29 percent had followed good preparation rules, 40 percent fair, and 31 percent poor. Through comparisons of the methods of preparation of 12 commonly used foods and through a study of new dishes tried during 1 year, findings suggest wide differences between white and Negro families in use and preparation practices and beween families of varied socioeconomic status living in towns of different soil areas.

Family economics studies made from farm income and expenditure account books kept by 346 farm families during 1934 to 1940 have been presented in a bulletin this year by the Kansas station. The study showed that net farm incomes varied from $958 in 1938 to $2,057 in 1935. In most of the years studied, families with 5 to 14 members, consisting of husband and wife and 3 or more adults, or husband and wife and 5 or more other persons regardless of age, had the largest net farm incomes. Families with 2 members, consisting of husband and wife only, averaged the lowest income for the period studied, with the exception of 1935. The average value of living for all families was $1,426.

A recently published study by the Wisconsin station of prewar and wartime incomes and expenditures for 106 Farm Security families was based on data for the years 1940 and 1942. Comparisons showed that wartime increases of gross income averaged 90.5 percent and net income 108.4 percent. Family living and savings, such as life insurance and war bonds, went up 71.2 percent, with an increase in expenditures for every commodity group—both in absolute amount spent and on the percentage basis. Allowing for increased living costs, however, the actual increase in family living was only 34.9 percent. Larger families reported less per capita expenditure for items other than food and clothing.

Workers at the South Carolina station interviewed 136 rural families of Pickens County, South Carolina, to obtain information relative to their food supply. Farm families were found to produce almost all of their food supply except sugar; the nonfarm families produced more than 50 percent of all their foods except sugars, fats other than butter, cereals, dried legumes, and nuts. Approximately 15 percent of all families studied were thought to have satisfactory food supplies throughout the year; 30 percent appeared to have inadequate supplies, although the average amount of money spent for food was not very different among the families rated as having good, fair, and poor food supplies.

Housing surveys were made by the Maine station in the summer of 1945 to determine the conditions of farm homes following the war

years and the plans the families had made to improve their housing. The results of the survey showed that 48 percent of the houses needed painting, 32 percent needed porches repaired, and 41 percent needed walls and ceilings refinished. These were major items from the standpoint of occurrence, but other exterior and interior repair needs were also listed.

A study of kitchen arrangements in farmhouses was made at the Illinois station to determine the types of activities carried on, the kinds of equipment used, and the suitability of the rooms for the activities. Fourteen distinct types of activity were found, including dining, resting, laundering, playing, dressing, preparation of produce for the market, bathing, in addition to the food preparation activities.

Based on population centers of 2,500 or less and individual housing units located in the open country, a study was made by the Pennsylvania station to investigate the adequacy of rural housing. When compared with that of other sections of the United States, Pennsylvania housing ranked favorably, having a higher proportion of rural homes equipped with running water, bathrooms, gas, and electrical appliances, although with a higher percentage of old houses in need of repair.

Rural housing conditions in southwestern and southeastern Oklahoma are described in a bulletin by the Oklahoma station. Wide differences were found to exist among owners and tenants, and almost without exception, housing of farm owners as a group rated higher than those of tenants on all items studied.

More than one-third of the New York farmhouses were built before the Civil War according to a report from the New York (Cornell) station. Information on these housing conditions was obtained from a survey made in Cortland County, N. Y., to determine the amount of postwar building planned, and the amount of remodeling, repairing, or improvements to be done. Members of the Rural Housing Research staff are compiling a set of basic house plans, for new houses and remodeling of old, which will present ideas and suggest ways of meeting building problems.

Household equipment studies have been reported by the Nebraska, Wyoming, and New Jersey stations regarding pressure cooker gauge testers. At the Nebraska station, workers have suggested materials and directions for constructing and assembling testers which check the gauge while it is still fastened to the lid.

The effects of the heights of ironing board surfaces on the homemaker have been studied at the New York (Cornell) station. The subjects used in the study were given the opportunity to try different heights for ironing, and in analyzing results of the physiological responses of the study, it was found that they selected a height at which their responses were most favorable.

A survey was made by the Illinois station to study laundering facilities and practices of rural homemakers. Many of the women interviewed considered the household laundry to be their most tiring task, and a review of the details of the study show that a lack of sorting and storing and washing and drying facilities caused an increase in the natural fatigue of the homemakers. Practical suggestions involving inexpensive, easily constructed or installed equipment or facilities were offered by the workers as a means of reducing the number of movements in washing.

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